the beginning. I have not attempted to defend the mutation theory of de Vries, but only to emphasize the fact that, before we criticize it, or lend to it either our dissent or assent, we must first understand it. The ink that was spilled in discussing misinterpretations of Darwinism far exceeds that poured out in recording constructive studies in evolution. Let us not make the same mistake and waste of energy in the present case.

The mutation 'theory' is still largely a working hypothesis. It is founded almost entirely upon experiment, and can be verified only by the same means. The beauty of it is that it is already reduced to a question of fact. For mere opinion and inference, and *a priori* impressions and prejudice, and inductions from field studies and comparative morphology there is absolutely no place. If one doubts the facts, let him repeat the experiments of de Vries and MacDougal and others. If he doubts that they represent a general truth, a fundamental principle in biology, then let him await the fullness of time, for it is by repeated experiment, among a wide range of groups, and *by experiment only,* that the general application must stand or fall.

And I bespeak also a candid acceptance of the facts, after they are clearly distinguished from the inferences. The latter are open to debate, but not so the former. And when a careful worker says that he obtained a given form that breeds absolutely true, and which, for reasons fully explained, he calls an 'elementary species,' by means of a certain definite and clearly explained kind of variation which he defines and names 'mutation,' let us not refer to him as 'claiming to' have done so, or to the mutant as 'seeming to' breed true.

Pregnant with significance as the mutation theory is for the systematic botanist and zoologist, its truth can never be established nor disproved by the methods of taxonomy. Comparative studies may offer worlds of evidence and multitudes of problems to test the hypothesis, but experimentation is the only possible means for the final solution.

How do species originate? A mass of facts suggests that the method is by the natural selection of fluctuating variations, combined with geographical isolation, influence of environment, and other factors. But, after all has been written, the undeniable fact remains that no one has yet ever actually observed the origin of a single species in this way.

On the other hand, the fact is just as undeniable that a definite and clearly defined type of variation, called an 'elementary species,' has been actually observed, not once, but often and by many, to arise by a process, equally well defined and definite, and known as 'mutation.' Mutations do furnish material for the operation of natural selection and all other influences that tend to establish a unit group known in taxonomy as a 'species.'

The case seems perfectly plain that the burden of proof rests with the adherents of fluctuation.

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SPECIAL ARTICLES.

A NEW FOSSIL SEAL FROM THE MARINE MIOCENE OF THE OREGON COAST REGION.

IN a bulletin recently issued by the Oregon State University, Professor Thomas Condon has given a description of an unusually interesting fossil pinniped, which was obtained by him from the Marine Miocene of the Oregon coast. It is, indeed, a happy coincidence that this nestor of Oregon geology should celebrate his eighty-fourth birthday by so interesting and important a discovery. This does not quite equal the record of the great chemist, Chevreul, before the French Academy, it is true, but it is one sufficiently rare in paleontology.

Professor Condon has kindly permitted me to make a careful study of this unique specimen, and I do not hesitate to pronounce it easily the most important find that has yet been made in this group. As far as I am aware the specimen represents an entirely new and hitherto unknown genus, intermediate in many respects between the sea lions and seals, with perhaps the most pronounced affinities with the latter, and at the same time exhibit-

ing a number of primitive or ancestral characters not found in the skeleton of any modern pinniped. He has appropriately named the new genus *Desmatophoca oregonensis*.

The age of the horizon in which this fossil was found is determined by Professor Condon to be Miocene from the association of a large number of characteristic genera of marine shells. Whether it represents the entire series of fresh-water deposits included in the Oligocene and Miocene of the interior continental region or whether it is equivalent to only a part of them can not now be determined. I think it may be safely assumed, however, to be the equivalent of the entire series, although its vertical thickness is considerably less than the contemporary fresh-water beds. The position of the fossil within the deposit was not accurately recorded but there is reason to believe that it comes from a layer which would suggest a Middle Oligocene age if referred to the interior series.

The point of greatest interest and importance in connection with the fossil under consideration is to be found in the light which it throws upon the broader question of the origin of this highly modified and almost exclusively aquatic branch of the carnivorous mammals. Hitherto an understanding of the more exact genetic connections between the Pinnipedia and the land Carnivora has proven a very obscure and perplexing problem to the morphologist, and as a result various opinions have been expressed concerning its solution. There seems, however, to have been entire unanimity of opinion in the hypothesis that the pinnipeds are descendants of some member of the land Carnivora and that their extreme modification has been due to the assumption of an aquatic habit with the attendant changes in structure necessitated by this environment.

Huxley held that the seals (using this term in its broader sense) have been derived from the bears and he attempted to point out similarities of structure between the two groups. In this view Mivart entirely concurred. The chief objections to this hypothesis are the following: The bears have now been pretty thoroughly proven by Schlosser to be descendants of the canoid or dog phylum, through *Amphicyon,* dating no further back than the later Oligocene or earlier Miocene. In the fossil seal before us we have a very distinct pinniped, at least equivalent in age to *Amphicyon* exhibiting no approach whatever to the dog or bear groups. This hypothesis may, therefore, be dismissed as wholly untenable.

The next expression of opinion on this subject was made by myself in describing the osteology of *Patriofelis.* In this publication I pointed out the large assemblage of creodont characters to be found in the skeletons of modern pinnipeds and from a careful analysis of these features in comparison with those of certain members of the Creodonta I was led to the conclusion that the seals are the direct descendants of the creodonts. I further held that the particular family among the latter which exhibits the closest approximation and furnishes the most likely ancestral beginnings thus far known is the Oxyænidæ.

Osborn, followed by Matthew and Scott, has dissented from this view and failed to discover any relationship between the creodonts and pinnipeds. Osborn's argument against the hypothesis was based wholly upon an effort to disprove the supposed aquatic or semiaquatic habits of certain of the Oxyænidæ, which he concluded were preeminently terrestrial or arboreal. Matthew's argument consists of a simple denial of the alleged relationship of the two groups. It now remains to reexamine the subject in the light of this newly acquired evidence and test the hypothesis of a creodont ancestry by this oldest and most primitive pinniped thus far discovered.

The specimen consists of a fairly well preserved skull in which the larger part of the dentition, especially that of the upper jaw, is present. The most important feature of the teeth is the evidence they afford of their derivation from a former more complex or tubercular condition. This is especially marked not only by the two- and three-rooted

manner of their implantation, but by the more complex structure of the crown of the fourth superior premolar as compared with that of the modern seals. This tooth may be said to be implanted by three roots, of which the one supporting the inner cusp is not entirely distinct at the base, at least. The crown exhibits the remains of three distinct cusps corresponding in every way to those of the less specialized sectorial of many of the creodonts. It is somewhat simpler in structure than the corresponding tooth of *Patriofelis,* but its derivation from a tooth of that character is clearly evident. The single molar, both above and below, is missing from the specimen, so that the organization of the crowns can not be determined. They were each implanted by two distinct roots. The dental formula is I. 3/2, C. 1/1, PM. 4/4, M. 1/1.

One character which is most unusual for a seal is the deep heavy horizontal ramus of the lower jaw, together with a relatively powerful symphysis reminding one at once of the corresponding parts of *Oxyæna* and *Patriofelis* among the creodonts. The impression which one immediately receives upon examination of the specimen is that of a short heavy-jawed animal. I mention this character in particular for the reason that the heavy jaw and powerful symphysis of *Patriofelis* was made the basis of an especial objection, on the part of Osborn, to any possibility of affinity between the two. The jaws of the modern seals are relatively weak and slender.

In the cranium the more important characters to be noted are the rudimental postorbital processes, the marked constriction of the postorbital region, the relatively heavy zygomatic arches and the peculiarly distinctive creodont organization of the otic region of the skull. The mastoid is of moderate proportions and the widely separated paroccipital process is unusually large and massive and projects outwards and backwards. This arrangement and unusual size of the paroccipital is one of the most distinctive characters of the creodont skull and is one not found in any of the modern Carnivora. I may add likewise that its condition in this ancient seal is almost identical with that seen in *Patriofelis* and *Oxyæna.*

The base of the skull had not been sufficiently freed from the inclosing matrix to permit of an accurate determination of the characters of this region, but I think the presence of a small rugged uninflated bulla and an alisphenoid canal may be assumed. The occipital crest is low and inconspicuous and does not overhang the occiput as in the creodonts. The brain case is large and roomy and the brain was considerably convoluted. In fact the brain case and occipital region of the skull resemble that of the modern *Phoca* closely.

From a consideration of the foregoing characters of this important specimen the following conclusions appear to be firmly and conclusively established: (1) the seals have been derived from ancestors in which the molars were tritubercular; (2) in which there were but two pairs of incisors in the lower jaw; (3) in which the true molars were early reduced; (4) in which the lower jaw was stout and heavy with a strong, heavy symphysis; (5) in which the mastoid region of the skull was identical with that of certain of the creodonts; (6) in which the postorbital process was rudimentary or wanting.

Less firmly established characters of the ancestors of the seals may be enumerated as follows: (1) Double tongue and groove articulations of the lumbar vertebræ; (2) early development of aquatic habits with consequent modification of limbs.

If next we direct our attention to the application of these characters to the known fossil Carnivora which preceded them in time, we find that it is only among the creodonts that these characters are to be met with. It, therefore, follows that a creodont ancestry is the only possible or logical solution of the problem. As to the particular family of creodonts from which the seals have been derived the evidence is by no means so clear nor conclusive. As far as now known the choice seems to be restricted to either the Hyænodontidæ or the Oxyænidæ. Of these the latter are

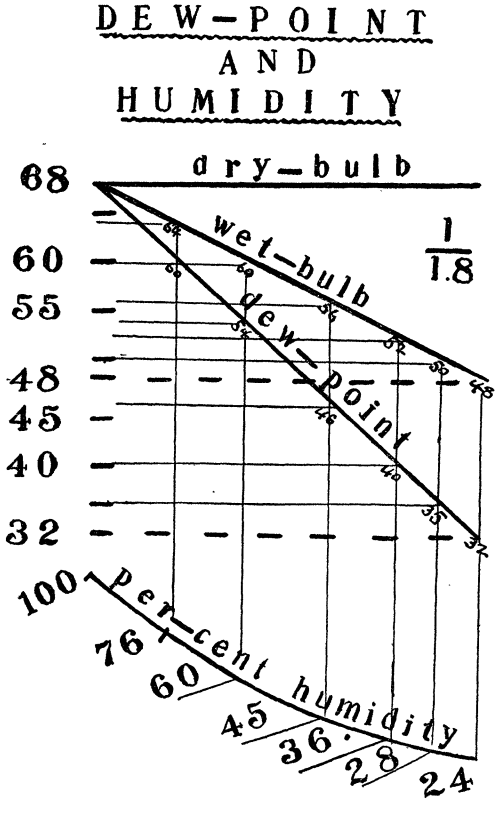
much the more likely, for the reason that all the conditions are more completely satisfied. No hyænodont is known in which the molars are reduced, whereas among the Oxyænidæ molar reduction is one of the most pronounced characters. In fact all the primitive characters are identical with those of this group. I take this occasion, therefore, to reaffirm the opinion I expressed on this subject some twelve years ago and I do so without modification or emendation.

J. L. Wortman.

McMurville, Oregon,
June 6, 1906.

DEW-POINT AND HUMIDITY CHART.

The chart shows dew-point and relative humidity in a room whose temperature is kept at about 68°. These are readily calculated from the readings of a wet-bulb thermometer kept in the room. So long as the temperature is kept near 68°—say between 66° and 70°—the difference between the readings of the dry-bulb thermometer and the dew-point is always about 1.8 times the difference between the readings of the dry- and wet-bulb thermometers. The percentage of humidity, which corresponds approximately to these readings, is shown in the curved line below.



John F. Woodhull.

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QUOTATIONS.

THE MOST IMPORTANT WORK IN THE WORLD.

The bringing of scientific agriculture into general practise is, we presume, the most important economic task that awaits us; and it is more than an economic task. In laboratories and on small experimental areas, methods have already been worked out which, if universally applied, would so increase the yield and the quality of our great crops, and consequently the profit of growing them, that the culture of the earth would become more profitable than commerce and manufactures. The ambitious young men have left the farms for the cities, from Abraham's day, if they had cities then, till our own, because they could make more money in trade and in similar pursuits; and the farmer, as a rule, has been the left-over man; and he will be so, till this economic situation is changed.

Great hopes were entertained a generation ago that the agricultural colleges would teach men scientific farming; and so they have; but most of the men who have thus been taught have themselves become teachers and have taught others who in turn have become teachers; and the man on the soil has, as a rule, not yet been reached with the new knowledge and with new methods.

Agricultural bulletins, too, have done good, but they have instructed those who least needed instruction; for the typical farmer does not learn farming by reading about it. Experiment stations have had a more direct influence and have caused better methods to be used in their neighborhoods.

But all these good agencies have yet failed to reach the mass of men who till the earth, the thousands and hundreds of thousands of